IEOR 153
Fall 2008 Sample Midterm

Instructions: Please write your name at the top of EACH page. Notes and books are not allowed. One hand-written sheet of paper to be turned in with the exam is allowed. Calculators are allowed. Show work where appropriate in order to get partial credit.

1. **Circle** T for true or F for false. If the statement is false, add, delete, or change **a few words** to make it true.

   (a) (T – F) Cross-docking is beneficial because although it increases warehouse inventory, it decreases lead times.

   (b) (T – F) The total cost per item of commodities purchased via an option contract is typically more than the total cost per item of items purchased via a long term or fixed commitment contract.

   (c) (T – F) Market research methods are more useful than time series forecasting methods for mature products.

   (d) (T – F) Risk pooling across markets is most effective if demand is negatively correlated.

   (e) (T – F) Forward buying is one way to reduce the bullwhip effect.

   (f) (T – F) As the number of warehouses increases, outbound logistics costs typically decrease.

2. You have just been hired as an operation analyst for Sur La Table, a kitchen gadget store on 4th Street in Berkeley. You have been assigned to the knife department, and your first assignment is to evaluate and recommend an inventory policy for two top selling knives, the Rachel Ray East-West Chef's Knife (RREWCK), and the Wusthof Classic Chef's Knife (WCCK). (26 points)

   You are given following information for the two products.

	Average Demand (per week)	Std. Deviation	Retail Price	Cost
RREWCK	150	50	89	59
WCCK	40	12	99	69

   Fixed order cost is 100$ per order per product. The order lead time for each product is one week. Inventory holding cost is 25% of inventory value per year.

   (a) Find the optimal time between orders if demand is constant, deterministic, and equal to the average demand given in the table.

   (b) Now, assume that demand is random, with normally distributed demand with the mean and standard deviation indicated in the table. Describe the appropriate inventory strategy if you are to employ a continuous review system. (i.e. specify when to place orders,

how much to order, etc.) Calculate the average inventory level of the system under the continuous review policy. Assume a service level of 95% ($z = 1.69$). Without calculations, discuss how a larger lead time for delivery would impact your results.

(c) Instead of implementing a continuous review system, Sur La Table is considering a periodic review system, with orders for both products placed every two weeks, or every four weeks. Describe the inventory strategy in both of these cases, calculate the cost in each case, and recommend one of the strategies. How does this strategy compare to the continuous review strategy? Assume a service level of 95% ($z = 1.69$).

(d) The manager at Sur La Table is debating whether or not to carry both of these knives. He figure that if he only carries the RREWCK, 85% of the customers who would have bought the WCCK would buy the RRWECK – the rest will go elsewhere. (In other words, combined average demand is 184 per week, with standard deviation 51.03). Should he only carry one knife? Are there any other factors he should consider?

3. Several of the articles that have been presented this year have discussed grocery stores and the products sold in grocery stores. Recently, there has been growing interest in organic fruits and vegetables, and there seem to be two types of companies that sell organic fruits and vegetables – large national companies that own a variety of farms located throughout the country and sell to a large number of large national chains, and individual small local growers that sell to a relatively small number of local stores. Consider two companies, one a large national organic produce supplier and one a small local organic produce supplier, and discuss two things that make the large national company's supply chain difficult to manage, and two things unique to the smaller company that make its supply chain difficult to manage.

4. Consider the iPod supply chain. This supply chain has many components, from the suppliers of the various chips and components, to Apple, to the distribution centers and stores of the retailers that sell iPods. Please keep your answers to the following questions brief! (20 points total)

   (a) Describe at least two specific ways that randomness and variability can make this supply chain difficult to manage.

   (b) Describe at least two specific ways that supply chain managers can reduce the negative effects of randomness and variability.

   (c) Describe a supply contract that can make this supply chain more profitable.

   (d) What if Apple only sold iPods directly from its own website? Describe at least one way that optimization could be used to manage the supply chain more efficient in this case.

5. Consider the fixed charge capacitated facility location model we discussed in class. Recall that in this model, we are trying to select some warehouses from a set of potential warehouse sites so that fixed and variable cost is minimized, and warehouses have a capacity constraint. The model is presented below, with positive parameters f_j representing the fixed cost of building at a potential site j, h_i representing the demand at customer i, d_{ij} representing the distance from retailer i to potential site j, K representing the capacity of a warehouse, and α representing the cost per unit distance per unit demand. The model also features the following variables:$y_{ij}, i = 1, 2, ...n, j = 1, 2, ...m$ is the fraction of demand of customer i

served by a warehouse at site j, and and $x_j, j = 1, 2, ...m$ is a binary variable which equals one if we locate at candidate site j, and 0 otherwise: (14 points)

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\begin{array}{lrcll}
(\mathbf{IP}) & \min \sum_{j=1}^{m} f_j x_j + \alpha \sum_{i=1}^{n} \sum_{j=1}^{m} h_i d_{ij} y_{ij} & & & \\
& s.t. & & & \\
& \sum_{j=1}^{m} y_{ij} & = & 1 & i = 1, 2, \ldots, n \quad (1) \\
& \sum_{i=1}^{n} h_i y_{ij} & \leq & K x_j & j = 1, 2, \ldots, m \quad (2) \\
& x_j & \in & \{0, 1\} & j = 1, 2, \ldots, m \quad (3) \\
& y_{ij} & \geq & 0 & i = 1, 2, \ldots, n, j = 1, 2, \ldots, m \quad (4)
\end{array}
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Suppose that you are trying to solve a similar problem, with a set of customers, a set of potential sites, and the same distribution costs we discussed in class, with a few changes. At each site, you can build either a small warehouse with capacity K_s or a large warehouse with capacity K_l, and at each retailer you can charge high price p_i^h or low price p_i^l. If you charge the high price, you experience low demand h_i^l, and if you charge the low price, you experience high demand h_i^h. Building a small warehouse costs f_j^s and building a large warehouse costs f_j^l. Your goal is to maximize profit, and each item costs you c. How would you modify this model to capture this situation? Note that you can change or add parameters, variables, the objective, and the constraints, as appropriate.